Weak Lensing Measurements of the Abell Catalog

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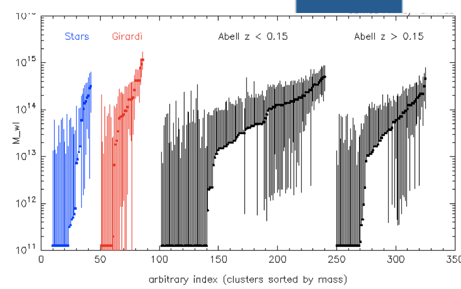
We are pursuing a program of measuring the weak lensing signal of the clusters in the Abell catalog inside the Sloan Digital Sky Survey.

There are 2071 Abell clusters inside the SDSS, counting multiple components as different clusters. For comparison, the maxBCG catalog has 13,823 clusters in this area at $0.1 \leq z \leq 0.3$.

As a calibration step we have measured the signal of the well studied clusters in Giaradi et al. 1998, of which there are 48 in the SDSS area. They have a mean z=0.04, lower than the Abell catalog, and massive clusters are over-represented.

As a control we measured 48 blank fields centered on stars, assuming a Girardi z distribution.

Below is a diagram showing the measured mass about the blank fields, the Girardi sample, and 216 Abell clusters in two different z slices. The measurements follow the procedure of Kubo et al, and use a photo-based catalog with at r < 21.5 and photo-z >= 0.20. Each cluster has its mean and 1σ error shown. Inside each sample the objects are ranked by their mass to produce the arbitray x-axis position. The points at 10^{11} $M_\odot$ have no (or negative) signal. Points without minus side error bars have signal but at lower than 1σ. From this plot we see that a) we make good measurements at 10^{15} $M_\odot$ masses, start making measurements with reasonable significance at $\geq 2 \times 10^{14}$ $M_\odot$, and that blank fields have a reasonable probability, ~10%, of having significant mass in the area. This latter is something that Hoekstra argues induces a systematic uncertainty in low-z weak lensing measurements (Hoekstra 2001, 2003, 2007).

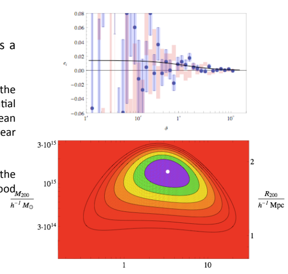


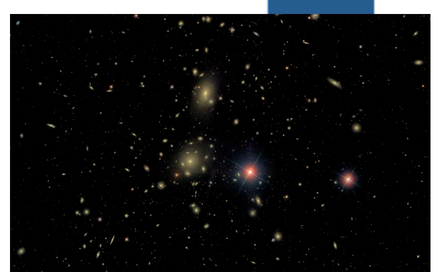
Coma

Coma is the classic massive relaxed cluster. It has a clean WL signal in the SDSS.

Top: The mean ellipticity in radial bins. Blue bars show the 1σ range of the tangential ellipticity, tan the orthotangential ellipticity, and magenta the overlap. The dots are the mean tangential ellipticity and overlaid is the best fit NFW shear profile.

Bottom: Likelihood plot of a 2-parameter NFW fit to the binned data. The contours show lines of constant likelihood at levels of 1/n where n=2,3,4…



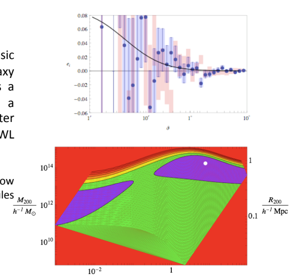


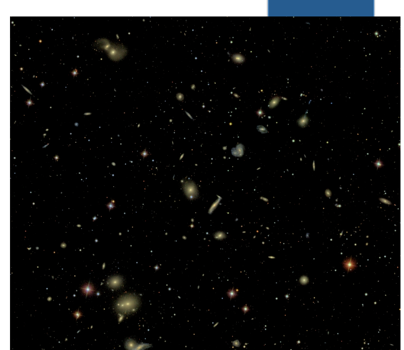
z = 0.023

Hercules

If Coma is the classic cluster, Hercules is the classic non-standard cluster. Most obviously it is disk galaxy dominated, though these disks are red. It lacks a dominant central galaxy, though it does have a luminous elliptical. Hercules is in a rich supercluster and other clusters in this supercluster show clean WL measurements. Hercules does not.

Bottom: Hercules shows a second likelihood peak at low c_{200} . This occurs in low significance clusters but in Hercules it is probably due to its complicated environment.



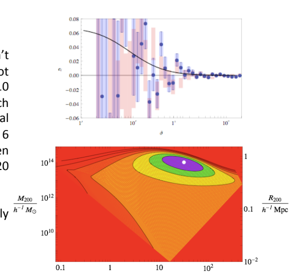


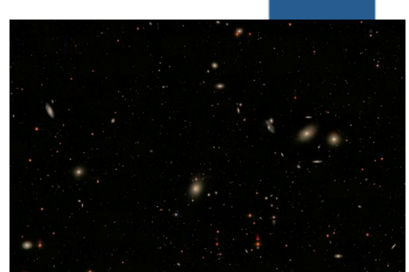
z = 0.037

Virgo

Virgo is the closest rich cluster, so close that it isn't included in the Abell catalog. Its richness does not compare with Coma and it has a mass roughly 5-10 less than Coma. These lower mass clusters are much more common then Coma. Virgo does have a central dominant galaxy, M87. Virgo is extremely close- 6 times closer than Coma. The core of Virgo is often taken to be 7 degrees and we work out to 20 degrees.

Virgo has a close to 2σ detection and is a reasonably clean.





z = 0.0038

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